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## Computer makes robot offspring

By MATTHEW FORDAHL-- The Associated Press

A computer programmed to follow the rules of evolution has for the first time designed and manufactured simple robots with minimal help from people.

The 20-centimetre automatons did not try to take over the world or even perform some simple task like vacuuming the lab. Instead, they crawled across a tabletop, exactly as they were digitally bred to do, said Jordan Pollack, a computer scientist at Brandeis University in Waltham, Mass.

"It's not what our robots do that is so surprising," he said. "They're not humanoid robots -- they don't raise their eyebrows and make you giggle. But what they did do was autonomously designed and manufactured."

Pollack and colleague Hod Lipson merged automatic manufacturing techniques with evolutionary computing. Their results appear Thursday in the journal *Nature*.

The computer that evolved the designs was told only what parts it would be working with, that its goal was locomotion and the physics of the environment in which its offspring would be



moving.

Over several days, the computer thought up different designs and methods of movement, creating traits that worked and failed. Like dinosaurs, woolly mammoths and dodo birds, the failures were cast into the dustbin of history.

The most promising designs survived and passed their success to future generations. Hundreds of generations later, three robots were manufactured by a prototyping machine.

"It evolved various kinds of locomotive mechanisms -- all surprising, given there was no human coming up with how to do it," Pollack said. "We got ratcheting motions. We got rolling motions. We got swimming motions."

The little white robots were made of bars, actuators, ball joints, motors and circuits. People intervened only to insert the motors into the plastic parts spit out by the prototyping machine.

By having a computer create designs using natural selection, researchers edged closer to solving two of robotics' biggest obstacles: robots' lack of versatility and their high cost of development.

Robots engineered by people typically function only under specific conditions with limited ability to adapt to changing situations.

A simple robot that vacuums a home, for instance, could cost millions to develop and sell for \$5,000 after engineers figured out a way to make sure it doesn't crash into furniture or fall down stairs, Pollack said.

"Then again, you could just hire a minimum-wage worker with a \$100 manual vacuum," he said. "The cost of building an intelligent humanoid robot is so high, we just can't get the economics going."

Ultimately, the Darwinian approach could revolutionize everything from manufacturing to space exploration.

"Down the road, if we could have a thing like this in space, you could send the building blocks and let them evolve themselves," said Yoseph Bar-Cohen,

**Jordan Pollack, left, professor of computer science at Brandeis University in Waltham, Mass., holds a "tetra" robot as he talks with fellow research scientist Hod Lipson, seen holding the "arrow" robot, Tuesday, Aug. 29, 2000, at the Dynamical and Evolutionary Machine Organization lab at Brandeis. The "tetra" and "arrow" robots are two successful designs that evolved in computer simulations, in which the objective was to travel the farthest on a flat surface. The two researchers say they have created a system in which computers evolve, design and manufacturer simple yet functioning robots with very little human intervention. (AP Photo/Julia Malakie)**

Photo of the Day



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director of a robotics lab at NASA's Jet Propulsion Laboratory. "That would be fascinating."

The next step will be to incorporate sensors into the robots so that success or failure in the physical world can be built into future generations.

It could be a difficult project, said Maja J. Mataric, a professor at the University of Southern California and director of the USC Robotics Research Labs.

"The authors very cleverly figured out a way to design a body and then actually manufacture it, which is an amazing feat," she said. "What is not at all clear is how to come up with a sensor design and manufacture it."

### Science Poll

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